

P. T. ENT COOPERATION TREATY

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
 United States Patent and Trademark
 Office
 Box PCT
 Washington, D.C.20231
 ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

Date of mailing (day/month/year) 10 August 2000 (10.08.00)	
International application No. PCT/US99/28588	Applicant's or agent's file reference BB 1289 PCT
International filing date (day/month/year) 02 December 1999 (02.12.99)	Priority date (day/month/year) 03 December 1998 (03.12.98)
Applicant CAHOON, Rebecca, E. et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 26 June 2000 (26.06.00)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Christelle Croci Telephone No.: (41-22) 338.83.38
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CC: AG BIOCH

MAR 13 2001

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

PCT

PATENT RECORDS
CENTER

To:

Andrew L. Schaeffer
E.I. DU PONT DE NEMOURS AND COMPANY
Legal/Patent Records Center
1007 Market Street
Wilmington, Delaware 19898
ETATS-UNIS D'AMERIQUE

KV

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing
(day/month/year) 07.03.2001Applicant's or agent's file reference
BB1289 PCT

IMPORTANT NOTIFICATION

International application No.
PCT/US99/28588International filing date (day/month/year)
02/12/1999Priority date (day/month/year)
03/12/1998

Applicant

E.I. DU PONT DE NEMOURS AND COMPANY et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

Name and mailing address of the IPEA/



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REY NOTED



03 JE 2001

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference BB1289 PCT	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/US99/28588	International filing date (<i>day/month/year</i>) 02/12/1999	Priority date (<i>day/month/year</i>) 03/12/1998	
International Patent Classification (IPC) or national classification and IPC C12N9/00			
Applicant E.I. DU PONT DE NEMOURS AND COMPANY et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 7 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☒ Priority
- III ☒ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 26/06/2000	Date of completion of this report 07.03.2001
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div> European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465 </div> </div>	Authorized officer Herrmann, K Telephone No. +49 89 2399 2670



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/US99/28588

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).):*

Description, pages:

1-36 as originally filed

Claims, No.:

1-25 as originally filed

Drawings, sheets:

1/7-7/7 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US99/28588

☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

see separate sheet

II. Priority

1. ☐ This report has been established as if no priority had been claimed due to the failure to furnish within the prescribed time limit the requested:

☐ copy of the earlier application whose priority has been claimed.

☐ translation of the earlier application whose priority has been claimed.

2. ☐ This report has been established as if no priority had been claimed due to the fact that the priority claim has been found invalid.

Thus for the purposes of this report, the international filing date indicated above is considered to be the relevant date.

3. Additional observations, if necessary:

see separate sheet

III. Non-establishment of opinion with regard to novelty, inventive step and industrial applicability

1. The questions whether the claimed invention appears to be novel, to involve an inventive step (to be non-obvious), or to be industrially applicable have not been examined in respect of:

☐ the entire international application.

☒ claims Nos. 2, 12 and partially claims 1, 3-11, 13-25.

because:

☐ the said international application, or the said claims Nos. relate to the following subject matter which does not require an international preliminary examination (*specify*):

☐ the description, claims or drawings (*indicate particular elements below*) or said claims Nos. are so unclear that no meaningful opinion could be formed (*specify*):

☐ the claims, or said claims Nos. are so inadequately supported by the description that no meaningful opinion

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/US99/28588

could be formed.

- ☒ no international search report has been established for the said claims Nos. 2, 12 and partially claims 1, 3-11, 13-25.

2. A meaningful international preliminary examination report cannot be carried out due to the failure of the nucleotide and/or amino acid sequence listing to comply with the standard provided for in Annex C of the Administrative Instructions:

- ☐ the written form has not been furnished or does not comply with the standard.
☐ the computer readable form has not been furnished or does not comply with the standard.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1, 3-11, 13-25
	No:	Claims	
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1, 3-11, 13-25
Industrial applicability (IA)	Yes:	Claims	1, 3-11, 13-25
	No:	Claims	

2. Citations and explanations
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/US99/28588

Citations

The documents mentioned in this International Preliminary Examination Report (IPER) are numbered as in the International Search Report dated 01.09.00, i.e. **D1** and **D6** correspond to the first and the last document of the search report, respectively.

Re ITEM I (Basis of the opinion)

The application as filed contains a sequence listing consisting of 34 pages (43 sequences).

Re ITEM II (Priority)

D5 and **D6** indicated in the search report as P-documents are not to be regarded as state of the art according to Rule 64(1)(b) PCT, as the date of priority claimed can be allowed for the relevant parts of the present application. Attention is however drawn to the fact that the priority document does not disclose the complete corn sequence (SEQ ID Nos:21 and 22 of present application) but only shows portions of SEQ ID Nos: 21 and 22 (SEQ ID NOs:1 and 2 of the priority document and of present application).

Re ITEM III (Non-establishment of opinion)

The International Preliminary Examining Authority (IPEA) agrees with the objection put forward by the International Searching Authority (ISA) as to lack of unity (Rule 13 PCT) and considers that the present application relates to 9 inventions. In response to an invitation, the Applicant did not pay additional search fees. Consequently, international search and preliminary examination have been restricted to the subject-matter of claims 1, 3-11 and 13-25 (all partially, corn sequence, SEQ ID Nos:2 or 22 (polypeptide), SEQ ID Nos:1 or 21 (polynucleotide)) which the ISA identified as invention 1.

R ITEM V (Novelty, inventive step, industrial applicability)

1 Novelty (Art. 33(2) PCT)

The subject-matter of claims 1, 3-11 and 13-25 has not been made available to the public by any of the available prior art documents and can therefore be regarded as novel.

2 Inventive step (Art. 33(3) PCT)

The subject-matter of claims 1, 3-11 and 13-25 does not meet the requirements of Art. 33(3) EPC.

It is not shown in present application that the sequences as in SEQ ID NO:1 and 21 code for a gamma-tocopherol methyltransferase (SEQ ID NO:2 or 22). The amino acid sequence is merely deduced from the nucleic acid sequence (cf. Table 8 on p. 26 of present description). The polynucleotides have neither been expressed nor have any functional tests been performed.

Moreover, according to **D1** (page 5/5) NCBI No. 1001725 or D64004, respectively, show the sequence of a delta(24)-sterol C-methyltransferase (EC 2.1.1.41). According to p. 22, l. 38 of present description the sequence similarity search was performed with said sequence. Thus, the sequence similarity search performed was not even based upon a gamma-tocopherol methyltransferase (EC 2.1.1.95) but on a delta(24)-sterol C-methyltransferase (EC 2.1.1.41).

Consequently, the IPEA is of the opinion that the problem underlying present "invention 1" (corn gamma-tocopherol methyltransferase) has not been solved by providing the sequences as in SEQ ID NO:1, 2, 21 and 22. The problem could thus be reformulated as merely being "the provision of a further nucleic/amino acid sequence". An inventive step can consequently not be acknowledged for the subject-matter of claims 1, 3-11 and 13-25.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/US99/28588

3 Industrial applicability (Art. 33(4) PCT)

Claims 1, 3-11 and 13-25 meet the criteria as set forth by Art. 33(4) PCT.

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference BB1289 PCT	FOR FURTHER ACTION <small>see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.</small>	
International application No. PCT/US 99/ 28588	International filing date (day/month/year) 02/12/1999	(Earliest) Priority Date (day/month/year) 03/12/1998
Applicant E.I. DU PONT DE NEMOURS AND COMPANY et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 6 sheets.

☒ It is also accompanied by a copy of each prior art document cited in this report.

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.

☐ the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :

☒ contained in the international application in written form.

☒ filed together with the international application in computer readable form.

☐ furnished subsequently to this Authority in written form.

☐ furnished subsequently to this Authority in computer readable form.

☐ the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

☐ the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the **title**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established by this Authority to read as follows:

5. With regard to the **abstract**,

☒ the text is approved as submitted by the applicant.

☐ the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.

☒ as suggested by the applicant.

☐ because the applicant failed to suggest a figure.

☐ because this figure better characterizes the invention.

1
☐ None of the figures.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/28588

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1, 3-11, 13-25 (all partially)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: Invention 1: Claims 1, 3-11, 13-25 (all partially)

Corn gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO: 2 or 22, polypeptide as in SEQ ID NO:2 or 22, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:1 or 21. Subject-matter relating to corn gamma-tocopherol methyltransferase.

2. Claims: Invention 2: Claims 1, 3-11, 13-25 (all partially)

Rice gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:4, 6, 24 or 26, polypeptide as in SEQ ID NO:4, 6, 24 or 26, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:3, 5, 23 or 25. Subject-matter relating to rice gamma-tocopherol methyltransferase.

3. Claims: Invention 3: Claims 1, 3-11, 13-25 (all partially)

Soybean gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:8 or 28, polypeptide as in SEQ ID NO:8 or 28, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:7 or 27. Subject-matter relating to soybean gamma-tocopherol methyltransferase.

4. Claims: Invention 4: Claims 1, 3-11, 13-25 (all partially)

Wheat gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:8 or 28, polypeptide as in SEQ ID NO:10 or 30, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:10 or 30. Subject-matter relating to wheat gamma-tocopherol methyltransferase.

5. Claims: Invention 5: Claims 2-10, 12-19, 21-25 (all partially)

Rice 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:12, 14 or 34, polypeptide as in SEQ ID NO:12, 14 or 34, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:11, 13 or 33. Subject-matter relating to rice 4-hydroxyphenylpyruvate dioxygenase.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

6. Claims: Invention 6: Claims 2-10, 12-19,
21-25 (all partially)

Soybean 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:16 or 36, polypeptide as in SEQ ID NO:16 or 36, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:15 or 35. Subject-matter relating to soybean 4-hydroxyphenylpyruvate dioxygenase.

7. Claims: Invention 7: Claims 2-10, 12-19,
21-25 (all partially)

Veronica 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:18, polypeptide as in SEQ ID NO:18, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:17. Subject-matter relating to veronica 4-hydroxyphenylpyruvate dioxygenase.

8. Claims: Invention 8: Claims 2-10, 12-19,
21-25 (all partially)

Wheat 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:20 or 38, polypeptide as in SEQ ID NO:20 or 38, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:19 or 37. Subject-matter relating to wheat 4-hydroxyphenylpyruvate dioxygenase.

9. Claims: Invention 9: Claims 2-10, 12-19,
21-25 (all partially)

Catalpa 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:32, polypeptide as in SEQ ID NO:32, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:31. Subject-matter relating to catalpa 4-hydroxyphenylpyruvate dioxygenase.

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IPC 7	C12N9/10	C12N9/02	C12N15/82	C12N15/29	C12N15/63
	C12N15/83	C12Q1/48	C12Q1/26	C12Q1/68	G01N33/50

B. FIELDS SEARCHED

IPC 7 C12N C12Q

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
------------	--	-----------------------

X DATABASE EMBL [Online]
Accession No. D64004,
4 October 1995 (1995-10-04)
"Synechocystis sp. PCC6803 complete
genome, delta(24)-sterol
C-methyltransferase"
XP002135563
see p. 22, l. 38 of present description:
1001725 corresponds to BAA10562 and D64004
the whole document

1,3-11,
13-25

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

^o Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

E earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

O document referring to an oral disclosure, use, exhibition or other means

P document published prior to the international filing date but later than the priority date claimed

*T later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

Y document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

12 April 2000

Date of mailing of the international search report

01 09.00

Name and mailing address of the ISA

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Authorized officer

Herrmann, K

INTERNATIONAL SEARCH REPORT

International Application No

PCT/IS 99/28588

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BARTLEY, G.E. ET AL.: "Cloning of an Arabidopsis thaliana cDNA for p-hydroxyphenylpyruvate dioxygenase (Accession No. U89267)" PLANT PHYSIOL., vol. 113, 1997, pages 1465-1465, XP002135561 the whole document	
A	& DATABASE EMBL [Online] Accession No. U89267, 19 March 1997 (1997-03-19) "Arabidopsis thaliana p-hydroxyphenylpyruvate dioxygenase (HPD) mRNA, complete cds" the whole document	
A	SHINTANI, D. AND DELLAPENNA, D.: "A new paradigm for plant biochemistry: Nutritional Genomics. Vitamin E synthesis and human nutrition as an example.", Abstract of the oral presentation at the annual meeting of The American Society of Plant Physiology, 28.06.1998 XP002135562 the whole document	
P,X	SHINTANI, D. AND DELLAPENNA, D.: "Elevating the vitamin E content of plants through metabolic engineering" SCIENCE, vol. 282, no. 5396, 11 December 1998 (1998-12-11), pages 2098-2100, XP000887122 the whole document	18
P,A	WO 99 04622 A (UNIV NEVADA) 4 February 1999 (1999-02-04)	

Information on patent family members

P S 99/28588

Form PCT/ISA/210 (patent family annex) (July 1992)

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D INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : C12N 9/10, 9/02, 15/82, 15/29, 15/63, 15/83, C12Q 1/48, 1/26, 1/68, G01N 33/50		A3	(11) International Publication Number: WO 00/32757
			(43) International Publication Date: 8 June 2000 (08.06.00)
(21) International Application Number: PCT/US99/28588		(81) Designated States: AE, AL, AU, BA, BB, BG, BR, CA, CN, CR, CU, CZ, DM, EE, GD, GE, HR, HU, ID, IL, IN, IS, JP, KP, KR, LC, LK, LR, LT, LV, MG, MK, MN, MX, NO, NZ, PL, RO, SG, SI, SK, SL, TR, TT, UA, US, UZ, VN, YU, ZA, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).	
(22) International Filing Date: 2 December 1999 (02.12.99)		Published With international search report.	
(30) Priority Data: 60/110,781 3 December 1998 (03.12.98) US		(88) Date of publication of the international search report: 23 November 2000 (23.11.00)	
(71) Applicant (for all designated States except US): E.I. DU PONT DE NEMOURS AND COMPANY [US/US]; 1007 Market Street, Wilmington, DE 19898 (US).			
(72) Inventors; and (75) Inventors/Applicants (for US only): CAHOON, Rebecca, E. [US/US]; 2331 West 18th Street, Wilmington, DE 19806 (US). COUGHLAN, Sean, J. [US/US]; 108 Stratton Drive, Hockessin, DE 19707 (US). MIAO, Guo-Hua [US/US]; 202 Cherry Blossom Place, Hockessin, DE 19707 (US). RAFALSKI, J., Antoni [US/US]; 2028 Longcome Drive, Wilmington, DE 19810 (US).			
(74) Agent: FEULNER, Gregory, J.; E.I. du Pont de Nemours and Company, Legal Patent Records Center, 1007 Market Street, Wilmington, DE 19898 (US).			

(54) Title: PLANT VITAMIN E BIOSYNTHETIC ENZYMES

(57) Abstract

This invention relates to an isolated nucleic acid fragment encoding a vitamin E biosynthetic enzyme. The invention also relates to the construction of a chimeric gene encoding all or a portion of the vitamin E biosynthetic enzyme, in sense or antisense orientation, wherein expression of the chimeric gene results in production of altered levels of the vitamin E biosynthetic enzyme in a transformed host cell.

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SEQ ID NO:39  NVYHVRPKHAL-----FLAFYCYFS-----
SEQ ID NO:40  NKATLAAPSSLSLTP-----YRTN55-FGSKSLLFRSP333333VS-MTTRGNV
SEQ ID NO:38  NNN-----SKRPA-PLTPHRLDAAPPFRPSLGHAAFPVPRPVLPLLPAR-XLRAPDGV
SEQ ID NO:28  NATVULI-----PTISGTHIFFRSQSPRTFARIKVGPRSNAPTRASA-ASSRGEI
SEQ ID NO:08  NATVULI-----PTISGTHIFFRSQSPRTFARIKVGPRSNAPTRASA-ASSRGEI
SEQ ID NO:22  NAAALLKCSQSSR-SLAACRGRSHYRAPSH-VPRHSLRLRAVSL-----R-PHASTA-
SEQ ID NO:24  AR--VQPTGALAPLPLRLCTSRHLCASAPRAGLCLKHRRRRSSRRTKLAVRAHAPT
SEQ ID NO:26  FRH-----GL-----AL-----60

SEQ ID NO:39  LUTNASAT1ABADLYEKIKNFYDSSGLMEDVNGHNGHNGYTGPHGTYRI-----DRAGAOI
SEQ ID NO:40  AVAAARTSTEA-----LANGIAEYMETSGMETWICOMHHNGHYFQSSVQLSSDHKEAOI
SEQ ID NO:38  VDRGPGDAAAPGLKEGAGLYDESSGLMESWGEHNGHNGFYDSGEAASHSD-----HRAAOI
SEQ ID NO:28  VLEOKPKKDDKKLQKGIACFYDESSGLMENWGDHNGHNGFYDSSTVSLSD-----HRAAOI
SEQ ID NO:08  VLEOKPKKDDKKLQKGIACFYDESSGLMENWGDHNGHNGFYDSSTVSLSD-----HRAAOI
SEQ ID NO:22  ----CAPATAPGLKEGAGLYDESSGLMENWGDHNGHNGFYDSGEAASHSD-----HRAAOI
SEQ ID NO:24  LSSSTAAAPGLKEGAGLYDESSGLMESWGEHNGHNGFYDAGEAASHSD-----HRAAOI
SEQ ID NO:26  -----61

SEQ ID NO:39  DLTKELLANAVPNSA-----KPRK1LDLQCGIGSSLYLAQHQAEVHGASLSPVQVERA
SEQ ID NO:40  RMIEESLRFAGVTDEEE-EKKIKKVVDVCGGIGSSRYLAKFGAECIGITLSPVQAKRA
SEQ ID NO:38  RMIECALAFAPV--DDPTMKRT1VDVCGGIGSSRYLANKYGAQCSGITLSPVQAKRG
SEQ ID NO:28  RMIEESLRFASV--SEERKVPKSI1VDVCGGIGSSRYLAKKIGATSVGITLSPVQAKRA
SEQ ID NO:08  RMIEESLRFASV--SEERKVPKSI1VDVCGGIGSSRYLAKKIGATSVGITLSPVQAKRA
SEQ ID NO:22  RMIECALAFAGVAPSDPEKTPKTI1VDVCGGIGSSRYLAKKYGQCTGITLSPVQAKRG
SEQ ID NO:24  RMIEESLATA-----121
SEQ ID NO:26  -----180

SEQ ID NO:39  GERAAALGISTCQFOVAMALDLPFASDSFDHVSLSGGERHNPKAQFLOCAHRLVKPGG
SEQ ID NO:40  HDLAAAGLSLHKASFOVADALDQPFDCQFDLVMSGESGERHNPKAQFVKELVRAVAPGG
SEQ ID NO:38  NALAAAGLSLHKASFOVADALDQPFDCQFDLVMSGESGERHNPKAQFVKELVRAVAPGA
SEQ ID NO:28  NALAAAGLADKVSFOVADALQOFFSDQFDLVMSGESGERHNPKAQFVKELVRAVAPGA
SEQ ID NO:08  NALAAAGLADKVSFOVADALQOFFSDQFDLVMSGESGERHNPKAQFVKELVRAVAPGA
SEQ ID NO:22  NALAAAGLSLQVTFLOVADALDQPFDCQFDLVMSGESGERHNPKAQFVKELVRAVAPGG
SEQ ID NO:24  -----ADPFDCQFDLVMSGESGERHNPKAQFVKELVRAVAPGA
SEQ ID NO:26  -----240

SEQ ID NO:39  RL1LATWCHRPIDPCHGFLTADSRHHLQAIYDVCFLPVVSLPDVEATARECGGELKTA
SEQ ID NO:40  R111VTWCHRHLSAGEALQPMQNLIDKICKTYLFAMCSTDPYVNLHSLSDI0KKA
SEQ ID NO:38  T111VTWCHRHLPSESLKPDGLHLKIKCOAYLPDMCSPSDYVVKIAESLSLEDITKA
SEQ ID NO:28  T111VTWCHRLDGPDEQSLHFWGQDLKKICDAYSFLAMCSTSDYVVKLLOSLSDI0KSE
SEQ ID NO:08  T111VTWCHRLDGPDEQSLHFWGQDLKKICDAYSFLAMCSTSDYVVKLLOSLSDI0KSE
SEQ ID NO:22  T111VTWCHRLDGPDEQSLHFWGQDLKKICDAYSFLAMCSTSDYVVKLLOSLSDI0KSE
SEQ ID NO:24  R111VTWCHRHLPSESLKPDGLHLKIKCOAYLPDMCSPSDYVVKIAESLSLEDITKA
SEQ ID NO:26  R111VTWCHRHLPSESLKPDGLHLKIKCOAYLPDMCSPSDYVVKIAESLSLEDITKA-----300

SEQ ID NO:39  DMSVAVPFWDRVIESAFDPVPMALQAGPKK11HAALCLALMNGYERGLVRFGLLTGI
SEQ ID NO:40  DMSHVAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO
SEQ ID NO:38  DMSHVAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO
SEQ ID NO:28  DMSRFAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO
SEQ ID NO:08  DMSRFAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO
SEQ ID NO:22  DMSHVAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO
SEQ ID NO:24  DMSHVAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO
SEQ ID NO:26  DMSHVAFPWPAVIRALTATWGLSLVSLRSGHKS1KALTHPLMIEGKGVKFGIITCO-----360

SEQ ID NO:39  KPLV-----
SEQ ID NO:40  KPLV-----
SEQ ID NO:38  KFOATEGEPEAASPEV-----
SEQ ID NO:28  K-----PE-----
SEQ ID NO:08  SYVTDRYFTR-----
SEQ ID NO:22  KPRAR--NA-----HALLMC
SEQ ID NO:24  K-----
SEQ ID NO:26  KPETY-----Q-----361
380

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INTERNATIONAL SEARCH REPORT

International Application No

PCT/US 99/28588

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 C12N9/10 C12N9/02 C12N15/82 C12N15/29 C12N15/63
C12N15/83 C12Q1/48 C12Q1/26 C12Q1/68 G01N33/50

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 C12N C12Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	<p>DATABASE EMBL [Online] Accession No. D64004, 4 October 1995 (1995-10-04) "Synechocystis sp. PCC6803 complete genome, delta(24)-sterol C-methyltransferase" XP002135563 see p. 22, l. 38 of present description: 1001725 corresponds to BAA10562 and D64004 the whole document</p> <p>---</p> <p>-/--</p>	1,3-11, 13-25



Further documents are listed in the continuation of box C.



Patent family members are listed in annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
- "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search

12 April 2000

Date of mailing of the international search report

01 09 00

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Herrmann, K

INTERNATIONAL SEARCH REPORT

International Application No.

PCT/US 99/28588

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	BARTLEY, G.E. ET AL.: "Cloning of an Arabidopsis thaliana cDNA for p-hydroxyphenylpyruvate dioxygenase (Accession No. U89267)" PLANT PHYSIOL., vol. 113, 1997, pages 1465-1465, XP002135561 the whole document	
A	& DATABASE EMBL [Online] Accession No. U89267, 19 March 1997 (1997-03-19) "Arabidopsis thaliana p-hydroxyphenylpyruvate dioxygenase (HPD) mRNA, complete cds" the whole document	
A	SHINTANI, D. AND DELLAPENNA, D.: "A new paradigm for plant biochemistry: Nutritional Genomics. Vitamin E synthesis and human nutrition as an example.", Abstract of the oral presentation at the annual meeting of The American Society of Plant Physiology, 28.06.1998 XP002135562 the whole document	
P,X	SHINTANI, D. AND DELLAPENNA, D.: "Elevating the vitamin E content of plants through metabolic engineering" SCIENCE, vol. 282, no. 5396, 11 December 1998 (1998-12-11), pages 2098-2100, XP000887122 the whole document	18
P,A	WO 99 04622 A (UNIV NEVADA) 4 February 1999 (1999-02-04)	

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 99/28588

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

See additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1, 3-11, 13-25 (all partially)

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

1. Claims: Invention 1: Claims 1, 3-11, 13-25 (all partially)

Corn gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO: 2 or 22, polypeptide as in SEQ ID NO:2 or 22, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:1 or 21. Subject-matter relating to corn gamma-tocopherol methyltransferase.

2. Claims: Invention 2: Claims 1, 3-11, 13-25 (all partially)

Rice gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:4, 6, 24 or 26, polypeptide as in SEQ ID NO:4, 6, 24 or 26, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:3, 5, 23 or 25. Subject-matter relating to rice gamma-tocopherol methyltransferase.

3. Claims: Invention 3: Claims 1, 3-11, 13-25 (all partially)

Soybean gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:8 or 28, polypeptide as in SEQ ID NO:8 or 28, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:7 or 27. Subject-matter relating to soybean gamma-tocopherol methyltransferase.

4. Claims: Invention 4: Claims 1, 3-11, 13-25 (all partially)

Wheat gamma-tocopherol methyltransferase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:8 or 28, polypeptide as in SEQ ID NO:10 or 30, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:10 or 30. Subject-matter relating to wheat gamma-tocopherol methyltransferase.

5. Claims: Invention 5: Claims 2-10, 12-19, 21-25 (all partially)

Rice 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:12, 14 or 34, polypeptide as in SEQ ID NO:12, 14 or 34, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:11, 13 or 33. Subject-matter relating to rice 4-hydroxyphenylpyruvate dioxygenase.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

6. Claims: Invention 6: Claims 2-10, 12-19,
21-25 (all partially)

Soybean 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:16 or 36, polypeptide as in SEQ ID NO:16 or 36, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:15 or 35. Subject-matter relating to soybean 4-hydroxyphenylpyruvate dioxygenase.

7. Claims: Invention 7: Claims 2-10, 12-19,
21-25 (all partially)

Veronica 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:18, polypeptide as in SEQ ID NO:18, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:17. Subject-matter relating to veronica 4-hydroxyphenylpyruvate dioxygenase.

8. Claims: Invention 8: Claims 2-10, 12-19,
21-25 (all partially)

Wheat 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:20 or 38, polypeptide as in SEQ ID NO:20 or 38, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:19 or 37. Subject-matter relating to wheat 4-hydroxyphenylpyruvate dioxygenase.

9. Claims: Invention 9: Claims 2-10, 12-19,
21-25 (all partially)

Catalpa 4-hydroxyphenylpyruvate dioxygenase:

Polynucleotide encoding a polypeptide as in SEQ ID NO:32, polypeptide as in SEQ ID NO:32, polynucleotide comprising a nucleotide sequence as in SEQ ID NO:31. Subject-matter relating to catalpa 4-hydroxyphenylpyruvate dioxygenase.

Information on patent family members

PCT/US 99/28588

Form PCT/ISA/210 (patent family annex) (July 1992)